DoD

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SPACE STATION QUESTIONS

1. The report states that a Space Station probably presents the most cost-effective alternative for satisfying existing and projected civil and commercial space requirements. Please provide the data to support this statement.

2. What are the specific existing space missions that are projected for the Space Station? Who are the users? Who will fund these missions?

3. What are the specific future space missions that are projected for the Space Station? Who are the users? Who will fund these missions?

4. Which space missions are unique to Space Station?

5. Under the Space Station Option 1, where will the following programs be funded?

   a. Teleoperator Maneuvering System

   b. Polar Platform

   c. Low Inclination Platform

   d. Space Based OTV

   e. Manned OTV Capsule

   f. Aft Cargo Carrier

   g. Crew Equipment

   h. Space Station Technology and Advanced Development

   i. Shuttle Derived Launch Vehicle

6. In what portion of the NASA budget are the Shuttle launch costs associated with the Space Station?

7. On what basis would any user charges associated with the Space Station be determined?

8. How much money is there for Space Station in the NASA baseline case? What will it fund?

9. How will a manned space station best fulfill national and international requirements versus other means of satisfying them? Specifically, what alternatives were evaluated?

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11. What rationale supports the contention that a commitment to Space Station must be made at this time?

12. NASA states that a permanently manned Space Station is required to maintain space leadership. Please define NASA's view of space leadership. What are the leadership objectives of NASA with respect to the civil space program? How does the permanently manned Space Station uniquely satisfy these objectives?

13. What is the NASA definition of a fully operational and cost-effective STS system and how do you plan to implement this National Space Policy directive while initiating the Space Station program? What is your long-range plan for maintaining this fully operational STS capability?

14. As we understand NASA's proposal, the initial complement of space station components is comprised of the following:

Elements

- Manned base in low inclination orbit
  - Crew of 6-8
  - Living quarters module
  - Utility module
    - .. electrical power
    - .. thermal control
    - .. attitude control
    - .. data processing
  - Docking hub
    - .. crew rotation and resupply 3-6 months
  - Two attached operations modules
    - .. scientific research and technology development requiring extensive manned interaction.
- Co-orbiting and polar unmanned platforms
    - .. Changeable payload accommodations for activities requiring minimum disturbance.

Please provide the time phased funding profile that supports these capabilities. Include cost estimates for the associated launch and mission support requirements as well as new support capabilities necessary to make the station operationally functional (i.e., additional TDRSS resources, teleoperators, etc.)

15. What is your projection of the life cycle cost for the permanently manned Space Station you propose?

16. Please update the NASA funding profiles (see example) through the end of the century by major program categories for the baseline and NASA Leadership programs.

17. What specific support activity is required to make Space Station a leadership program?

25X1

D-1. The report states that a Space Station probably presents the most cost effective alternative for satisfying existing and projected civil and commercial space requirements. Please provide the data to support this statement.

The conclusion that "Space Station probably presents the most cost effective alternative" was derived from the Mission Analysis studies developed by the eight aerospace contractors, plus the inhouse effort that took place from May 20 to July 15 by the Mission Synthesis Working Group and the Concept Development Group. Personnel from the DOD participated in these exercises.

NOT THE MOST OBJECTIVE ANALYSIS

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D-2. What are the specific existing space missions that are projected for the Space Station? Who are the users? Who will fund these missions?

For purposes of answering this question, "existing" is assumed to mean missions that are currently in the: (A) hardware phase, (B) definition phase or, (C) conceptual planning phase.

The missions will be reviewed by mission category.

The astrophysics missions are planned and funded by NASA's Office of Space Science and Applications (OSSA). The existing missions include free flyers (such as Space Telescope, Gamma Ray Observatory and Solar Maximum Mission) that will be serviced from the Space Station, plus telescopes and other instruments (such as Starlab, Solar Optical Telescope and Spectra of Cosmic Ray Nuclei) that will be flown on the Space Station or space platform.

The earth science and applications missions are planned and funded by NASA/OSSA. These missions include a variety of instruments that gather data from the earth, sun and the area between the earth and sun. Present planning is to group most of these instruments on a polar space platform so that the data can be coordinated. Collectively, these instruments are referred to as the Earth Science Research mission. A LIDAR facility to obtain data about atmospheric composition is also planned although the Space Station will probably be required to bring this mission to maturity. (The instrument is very complex and requires manned interaction).

The solar system exploration missions are planned and funded by NASA/OSSA. These are launches of probes and fly-by missions to Mars, Venus, Titan, Saturn, comets and asteroids. In the conceptual planning stage is a Mars Sample Return mission that can be accomplished if the Space Station becomes a reality.

The life sciences missions are planned and funded by NASA/OSSA. These include research on humans, animals and plants to understand the effects of gravity on life forms. In anticipation of a Space Station, planning has also begun on missions to develop closed environmental life support systems.

The communications missions include a communications test lab on-orbit and the deployment of numerous geosynchronous satellites. In anticipation of a Space Station, conceptual planning has begun on geosynchronous launches and servicing missions utilizing space-based reusable OTV's. Storage of satellites on-orbit, to be reconfigured and deployed by OTV to replace failed satellites, is also in the conceptual planning stage. After some initial technology demonstration missions, the majority of these missions would be planned and funded by satellite buyers and/or manufacturers.

Some materials processing experiments are planned and funded by NASA alone and others are planned and funded by NASA working jointly with industry. The materials processing production units will be funded entirely by industry. At this time, the Electrophoretic Separation process and the Gallium Arsenide-Electroepitaxial Crystal Growth units are scheduled as production units on the initial station. These are planned and funded by McDonnell Douglas/Johnson and Johnson and Mircogravity Research Associates respectively. In the planning phase are other research and production units such as Optical Fiber Production (Boeing), Iridium Crucible Production (Johnson Matthey Company) and HgCdTe Crystal Production (Grumman, Boeing).

The technology development missions are planned and funded by NASA, - primarily the Office of Space Flight (OSF), although these missions probably have applicatons for other agencies and for commercial users. The missions currently being planned include Satellite Servicing Technology, OTV Servicing Technology, Large Space Strucutres Technology, Large Space Antenna Technology, and Telepresence/EVA Technology. Numerous other technology development missions are in the conceptual planning stage.

The Space Station enables a considerable number of missions. The Office of Space Science and Applications (OSSA) budget would be expected to increase accordingly to account for this increased capability. In addition, the space techology costs would be expected to be approximately double the technology development missions. More details concerning these budget increases is answered in question D-16.

D-3. What are the specific future space missions that are projected for the Space Station? Who are the users? Who will fund these missions?

Future space missions projected for the Space Station will be discussed by mission categories. Please refer to Question D-2 for funding references.

The future astrophysics missions include large, advanced detector systems such as the Advanced Solar Observatory and the Large Deployable Reflector.

The future earth science and applications missions will utilize sophisticated combinations of the presently availble instruments plus newly developed instruments with increased resolution and data gathering capability. The new instruments will be added to the polar space platform or will replace older instruments.

The future solar system exploration missions will probably take advantage of Space Station transportation node and on-orbit assembly capabilities. The Mars Sample Return mission (the first mission of this type) is presently under conceptual development.

The life sciences missions will be expanded to include very long term studies of plants and animals in space, and to develop closed environment facilities for space habitation.

The future commercial missions include checkout, assembly and deployment of geosynchronous satellites from the Space Station via space- based OTV. Servicing of satellites at geosynchronous orbit is planned, as is storage of spare satellites on the Space Station for speedy deployment by OTV to replace failed satellites.

The complement of future materials processing experiments is difficult to list completely because most of these missions will be developed by research in the Space Station Research and Development Laboratory. Some of the commercial production processes that are expected to be developed in this laboratory include: Optical Fiber Production, Solution Crystal Growth Production, Iridium Crucible Production, Biological Processes Production and Merged Technology Calatyst Production.

Future Space Station missions are also expected to include the Remote Sensing Test/Development Facility and advanced earth and ocean testing instruments such as the stereo multi-linear array.

The future technology development missions include advanced versions of Satellite Servicing, OTV Servicing and Large Space Structures development. Other missions will develop the capability to construct large space antennas and deploy them to geosynchronous orbit. Many of the technology development missions will develop capabilities for the evolutionary Space Station.

D-4. Which space missions are unique to Space Station?

The missions unique to the Space Station are those that: (1) require on-orbit assembly or construction; (2) require satellite servicing at geosynchronous orbit; (3) require on-orbit storage, reconfiguration, and deployment of satellites; and (4) require the combinations of long time on-orbit with manned interaction -- such as the materials processing and life sciences missions. AS NSBF

Examples of missions which would be unique to the Space Station are:

- Large Deployable Relector - assembled at Space Station.
- LIDAR Facility - long duration - extensive manned interaction.
- Space Plasma Physics - a portion of this research that requires coordination of manned and unmanned experiments is unique to the Space Station.
- Mars Sample Return - requires boost capacity equivalant to two Centaurs and on-orbit assembly; will use a special Space Station sample return laboratory.
- Closed Environmental Life Support and Other Life Sciences Experiments - require long duration with manned interaction.
- Communications Test Lab - requires man-controlled testing over long periods.
- Satellite Servicing at Geosynchronous Orbit - requires space based OTV.
- Exchange Reconfigured Satellite Spares On-orbit - requires Space Station storage/reconfiguration and OTV delivery.
- Remote Sensing Test Development and Verification - requires extensive manned interaction with long time on-orbit.
- Deployment/Assembly/Construction (of large antennas, etc.) - requires Space Station construction base and development of space construction techniques.
- Large Space Antenna - requires Space Station development of control and construction techniques.
- Materials Processing in Space Laboratory - requires manned interaction on-orbit with extensive time for iterative experimentation.
- Optical Fiber Production - assumed to be enabled by Space Station experimentation.

- o Selection Crystal Growth - assumed to be enabled by Space Station experimentation.
- o Iridium Crucible Production - enabled by Space Station low-g and vacuum faciltles.
- o Biological Processes - assumed to be enabled by Space Station experimentation.
- o Merged Technology/Catalyst Production - assumed to be enabled by Space Station experimentation.
- ± Other materials processing missions developed in Space Station research and development.
- o A planetary observation telescope at the Space Station is in the initial conceptual stage.
- o The Solar System Exploration Committee is currently reviewing the impact of the Space Station and is expanding solar system exploration missions to take advantage of the Space Station capabilities. Missions under review, in addition to the Mars Sample Return Mission, include: a return to the moon by men, manned exploration of near-earth asteroids, and technology preparation for a manned Mars mission.

D-5. Under the Space Station Option 1, where will the following programs be funded?

a. Teleoperator Maneuvering System

b. Polar Platform

c. Low Inclination Platform

d. Space Based OTV

e. Manned OTV Capsule

f. Aft Cargo Carrier

g. Crew Equipment

h. Space Station Technology and Advanced Development

i. Shuttle Derived Launch Vehicle

All of these items would be funded by NASA as part of the civil space program at such time that they are approved by the President and the Congress for inclusion in the NASA budget. SURE

D-6. In what portion of the NASA budget are the Shuttle launch costs associated with the Space Station?

Are Costs Accounted For

The Shuttle launch costs would probably be included in the operations segment of the Office of Space Flight budget, as are all other Shuttle launch costs associated with NASA missions.

D-7. On what basis would any user charges associated with the Space Station be determined?

It is premature to declare the Space Station user charge policies; however, it is expected they would be derived in much the same manner as the Shuttle user charges and, to a great extent, based upon Shuttle and Spacelab experience. The elements required to operate and maintain the Space Station, e.g,, the crew consumables (water, food, clothing, atmospheric gases), propellants, logistics items (spares) and required ground support personnel would probably constitute the basis for user charge.

D-8. How much money is there for Space Station in the NASA baseline case? What will it fund?

Our current preliminary estimate for the initial DDT&E increment of the Space Station is $8 billion (in 1984 dollars). This presumes an immediate presidential commitment to undertake a Space Station program, a 1987 start of development, and a 1991 IOC. The complement of assets in this initial increment is cited in question D-14.

a. FOC For SS —

b. O&M For SS —

c. USER FUNDS TO EXPLOIT SS —

D-9. How will a manned space station best fulfill national and international requirements versus other means of satisfying them? Specifically, what alternatives were evaluated?

The response to this question has been submitted to the National Security Council on July 1, 1983, as one of the issue papers in response to NSSD 5-83. The issue paper is attached.

"HOW WILL A MANNED SPACE STATION BEST FULFILL NATIONAL AND INTERNATIONAL REQUIREMENTS VERSUS OTHER MEANS OF SATISFYING THEM?"

INTRODUCTION

National Security Study Directive 5-83, dated April 11, 1983, directs NASA to address the above issue in terms of four operational scenarios which are also specified in the same Directive. These scenarios represent several different approaches to meeting the future space activity requirements of both the United States and our international partners. They include the use of the Space Transportation System (Shuttle), unmanned space platforms, and manned space stations. The study of this issue is a part of current effort to determine the role of a manned space station in meeting our future space activity requirements.

BACKGROUND

Historically, man has demonstrated a remarkable adaptability to space and has steadily assumed increasingly challenging roles. In Mercury, man was largely a passenger. However in Apollo, man demonstrated other, more demanding roles: a skillful pilot landing Apollo 11 on the Moon under manual control, a resourceful, emergency repairman in Apollo 13, and a sophisticated explorer in Apollo 17. In Skylab, man demonstrated a surprising capacity to do useful work in weightlessness. Indeed, man's skill as a repairman in erecting a makeshift sun shade may have saved the Skylab as a useful laboratory. Man's ability to improvise solutions to unforeseen circumstances repeatedly led to the successful completion of investigations that would otherwise have been lost. While it is possible to construct automated systems that easily exceed man's strength, speed, dexterity, sensitivity, etc., such systems are deterministic and can deal effectively only with those contingencies that were foreseen by the designers. In tasks where the processes and outcomes are not well understood, man's participation can improve both the quality and quantity of collected data and thus accelerate the progress of scientific understanding. Looking beyond Skylab, a manned space station would provide indefinite stay on orbit and far greater flexibility due to the Shuttle. In such a station, man would continue in his traditional roles and would acquire new roles.

NASA has studied space station concepts since the late 1960's and it was evident that a manned space station required the routine access to space afforded by the Shuttle. The decision was made to proceed with the Shuttle development first. The Space Transportation System is now operational and prepared to carry heavy payloads to low earth orbit. Furthermore, the availability of a space station would allow the Shuttle to operate more efficiently for two reasons. In the first case, the Shuttle need not be used as a means of providing weightless exposure; the space station provides this capability. Thus the Shuttle can now go directly to and from the space station and consequently make more trips in a given period of time. In the second case, carrying space parts, fuel, raw materials, laboratory equipment, and a variety of other things to the space station allows the Shuttle to operate at a 100% load factor. Abroad, the United States' lead in space technology is shrinking. The Soviets appear to have made a fundamental and abiding commitment to manned space flight. Among our allies, ESA and Japan are making good progress in aerospace technology and are not only able partners, but ready competitors in the future commercial development of space. A national commitment to a manned space station would address all of the above issues: a permanent presence in space, a new commitment to manned space flight, enhanced efficiency for the Shuttle, an advantage in the commercial development of space, a resurgence of U.S. leadership in space technology, and the creation of a base camp for the practical use and future exploration of space.

REQUIREMENTS

Civil space activity requirements have been established by NASA through a lengthy compilation of commercial, academic, and governmental sources. Through multiple discussions with ESA and the Japanese, NASA has established that international space activity requirements are qualitatively similar to U.S. requirements. This mission model consists of some 107 separate missions to be initiated before the year 2000. In this model, a "mission" is not always a single flight but a family of flights involving the same or similar scientific objectives and instrumentation. Functionally, a "mission" usually represents a project. These requirements have been published as a separate document (1) and are not presented here.

DISCUSSION

Compared to the available alternatives, a manned space station uniquely provides the combination of long duration on orbit and the opportunity for intensive manned involvement. Of the nine disciplines in the mission model, there are six that are particularly enhanced by the presence of a manned space station. These are Astrophysics, Solar System Exploration, Communications, Life Sciences, Materials Science and Commercial Materials Processing, and Technology Development.

A space station presents several significant opportunities to Astrophysics that are not available in any of the other alternatives. The first of these involves the assembly of large observatories in space, thus bypassing the severe and even prohibitive burden of launching in the observing configuration. There are a number of observatories that have already been described in the literature and in planning sessions that will capitalize on this capability. The assembly of large apertures in space provides high resolution observation of the heavens in all spectral bands. Such information will provide new understanding of the evolution of the universe and the fundamental laws that govern matter and energy. The following serve as detailed examples: the Orbiting Very Long Base-Line Interferometer, the Infrared/Submillimeter Telescope, the Ambient Deployable Infrared Telescope, the Very Large Telescope, and finally, the Coherent Optical System of Modular Imaging Collectors. All of these payloads are beyond the launch capability of any known booster and all press the launch capability of the Shuttle itself. The Shuttle may well be able to carry a subset of the materials into orbit to assemble one of these observatories. However, the limited stay time, crew complement, and assembly facilities of the Shuttle would all but preclude the level of assembly and orbital verification that any one of these systems would require.

In a related way, it will be possible to aggregate payloads in the vicinity of a space station even though several Shuttle launches may be involved. By aggregating payloads, they become individually less expensive since the replication of utility support thereby can be avoided.

Lastly, the opportunity to service, repair, and reconfigure payloads can considerably reduce the cost of data collection by lengthening the active life of a given satellite. Although the Shuttle can also perform this activity, utilizing the space station as a parts and fuel depot, and as the base for both the teleoperator maneuvering system and the orbital transfer vehicle, a rich variety of service capabilities are provided at lower cost than in the alternative approaches to acquire the same capabilities.

Solar System Exploration is enhanced by a space station in ways that are not available in the other scenarios. By establishing a space station fuel depot that is supplied largely by cryogens carried on the payload margin of the Shuttle, it will be possible for a space station to function as a transportation node to higher energy orbits beyond the region of the earth. The alternative to this approach is to construct very large boosters for launch directly from earth. The kinds of missions that might depend on this capability include the Mars Sample Return Mission, a manned lunar base, and a survey of near-earth asteroids. Currently, only the Mars Sample Return Mission is contained in the present mission model.

Communications can significantly benefit from utilizing a space station. The capability to assemble, check, and launch aggregated payloads of communication satellites to geosynchronous orbit is economically attractive, particularly when employing a reusable orbital transfer vehicle. The alternatives are either the use of expendable boosters launched from the Shuttle or the use of much larger expendable boosters launched from the ground.

Life Sciences requires both continuous, long duration on orbit and very intensive crew involvement. These investigations generally examine the physiological effects of chronic weightlessness. Weightless exposure produces shifts in physiological functions that are significant in terms of terrestrial standards. Whether these shifts will stabilize or go on to acquire medical significance is not yet known. To answer this question requires long duration on orbit. In addition, several instances in developmental biology have been identified that are clearly gravity sensitive and the study of the effects of weightlessness on mammalian development represents a high priority research objective. To gain a better understanding of gravitational biology is not only of great scientific interest but of considerable practical value in enabling man's permanent presence in space.

Materials Science and Commercial Materials Processing also require long term weightlessness and intensive crew involvement. These investigations explore the use of weightlessness to develop both new materials and less expensive techniques to manufacture goods aloft. Recent experiments dealing with the electrophoretic separation of albumen on the Shuttle have demonstrated dramatic capabilities beyond those available in the same hardware when operated on earth. This technique promises to isolate medicinal substances of commercial value that would not be economically affordable using current earth-based techniques. Other areas that appear promising for space manufacture include semiconductor crystals, better alloys, and the ultrapure manufacture of glass products.

Lastly, Technology Development is significantly dependent on crew interaction and the facilities of a space station. Proposed activities span a broad spectrum of space activities and include such areas as large structures, space craft systems technology, enhanced instruments technology for earth observations, and human capabilities in space. Of the nine disciplines in the mission model, Technology Development requires the largest amount of extravehicular activity.

ALTERNATIVES

National Security Study Directive 5-83 establishes four scenarios which are to be compared. Scenario I involves the Shuttle with existing and planned improvements. Scenario II involves the addition of two unmanned platforms to Scenario I, one at an inclination of 28.5° and the other at 90°. Scenario III involves the addition of an evolutionary manned station to Scenario II. The station is located at an inclination of 28.5° and has a space-based orbital transfer vehicle. Scenario IV adds another manned station to Scenario III; this second manned station is located at an inclination of 90°. The details of this effort are reported in a separate document (2).

Scenario I involves the use of the Shuttle with a mission duration ranging from 7-20 days. When compared to a manned space station, the critical comparison involves the length of time available in weightlessness. Of all the tasks and investigations requiring crew involvement, many can gather useful data in 20 days of orbital flight. However, many others, particularly in Life Sciences, Materials Processing, and the Technology Development Missions, require long periods of uninterrupted weightless exposure and are therefore of limited value on the Shuttle. These efforts can reach their full scientific potential only on a manned space station. Considering the entire mission model, practically all of the investigations are improved by lengthening the time on orbit. Associated with the opportunity for longer duration on orbit, is a lower cost per day on orbit. For example, an investigation requiring 60 days on orbit is accommodated with a single Shuttle launch on space station but would require three launches for completion if conducted on the Shuttle, assuming continuous weightless exposure was not required.

Scenario II involves the Shuttle and two unmanned platforms, one at an inclination of 28.5° and the other at 90°. When compared to a manned station, the unmanned platforms offer excellent stability, low contamination, and long duration on orbit. In this case, the critical comparison involves the availability of crew members to conduct research, supervise, adjust, maintain, modify, or repair systems in and around the space station. Lacking a manned presence, the unmanned platforms must depend on teleoperation and/or complex automated systems to perform all functions. Servicing is available from the Shuttle, but would likely be less expensively accomplished by men already in orbit. A permanent manned presence in low earth orbit also allows the assembly of large structures in space which includes large satellites and their subsequent launch into more distant, higher energy orbits. Man's continuous availability to assemble, check, service, and launch such systems is a capability not practically available from the Shuttle alone. In addition to serving as a transportation node, the space station can also serve as a information node where man integrates complex space-based data streams prior to selective transmission to earth. Considering the mission model, most of the Technology Development Missions, as well as those in Life Sciences and Materials Processing, are so dependent on a continuous manned presence that the unmanned platforms represent limited opportunities in these areas.

Scenario III consists of the Shuttle, a manned station capable of evolutionary growth and an unmanned platform both at an inclination of 28.5°, and another unmanned platform at an inclination of 90°. Scenario IV consists of the Shuttle and a manned station and an unmanned platform both at an inclination of 28.5° and 90°. This scenario does not specify an evolutionary growth but a rapid acquisition of all elements. These scenarios involve many desirable features and are the only scenarios which accommodate the entire mission model. Due to the evolutionary growth of Scenario III, it has lower initial costs than Scenario IV but can easily be expanded to the capabilities of Scenario IV.

Scenarios III and IV demonstrate the use of unmanned platforms and manned space stations in a complementary fashion. The manned station accommodates all of those missions requiring crew involvement and long duration exposure to weightlessness and simultaneously provides assembly, service, parts storage, and repair to payloads attached to a co-orbiting unmanned platform that can confidently meet the strict stability and contamination requirements of certain missions. The principle behind this complementary relationship involves the use of automated systems to enhance mission performance and the use of crew involvement to enhance the flexibility and reliability of the automated systems. Man has repeatedly demonstrated that through the use of his intellectual and sensorimotor skills he can improvise successful solutions to unforeseen problems. The space station represents a permanent projection of these unique capabilities into low earth orbit.

SUMMARY

National Security Study Directive 5-83 poses the question as to how a manned space station best meets the national and international space activity requirements. Through a lengthly compilation of varied sources, NASA has recently published a mission model for the period 1991-2000. When the four operational scenarios specified in the above Directive are compared in terms of this mission model, the complementary use of a manned station at 28.5°, an unmanned platform at the same inclination, and another unmanned platform at 90° represents the approach with the fewest basic elements that meets all of the requirements of the mission model. Compared to the various alternatives, the manned space station uniquely offers the combination of indefinite, continuous weightless exposure and intensive crew involvement. This combination is essential for a number of missions in the mission model. The station also provides more economical satellite servicing and storage facilities, the maintenance and modification of co-orbiting unmanned platforms, the construction of large structures in low earth orbit, and a more economical method of launching satellites into higher energy orbits.

REFERENCES:

1. Summary of Space Station Requirements 1991-2000. Space Station Task Force. May 23, 1983.

2. A Report to the Senior Interagency Group (SIG), Working Group for Space Station. June 24, 1983.

D-11. What rationale supports the contention that a commitment to Space Station must be made at this time?

Given the accelerated space program of the Soviet Union, a United States commitment to a Space Station is required now to sustain United States leadership in manned space operations in the early 1990's. NASA firmly believes, as a result of studies conducted to date, that the Space Station program must initiated now if we are to have an initial operating capability in 1991. The Shuttle is rapidly becoming operational and the capability is available for Space Station development, without adversely affecting the Shuttle program. Moreover, an assessment of the mission requirements for Space Station use during the 1990's indicates that the sooner we establish an operational capability, the quicker the benefits will accrue.

False

why

Not PROVEN

D-12. NASA states that a permanently manned Space Station is required to maintain space leadership. Please define NASA's view of space leadership. What are the leadership objectives of NASA with respect to the civil space program? How does the permanently manned Space Station uniquely satisfy these objectives?

Leadership in space, as pointed out in the Space Strategy paper submitted by the NASA Administrator James Beggs to Judge Clark on May 31, 1983, requires preeminence in space science and applications, preeminence in space technology, and preeminence in manned space flight. A United States Space Station is essential to maintaining leadership in space. It offers a permanence in space to scientific and applications assets that could then be efficiently maintained and repaired. It offers new and multiple challenges in space technologies, in such fields as data management, thermal controls, teleoperator systems, and overall systems autonomy. It offers the first real potential for realizing commercial production of new materials such as extremely pure crystals and pharmaceuticals. Finally, it enables the unique advantages of man, his adaptability, his intelligence and his judgement, to be fully exploited in the environs of space.

Say what?

D-13. What is the NASA definition of a fully operational and cost effective STS system and how do you plan to implement this National Space Policy directive while initiating the Space Station program? What is your long-range plan for maintaining this fully operational STS capability?

A fully operational STS is one that supports the projected needs of the national security, civil, and commercial communities and adapts to changing needs, and assures that each mission is safe and successful and maintains the operational schedules.

The first priority of the STS program is to make the system fully operational and cost-effective in providing routine access to space. The STS program thus has extremely high priority in NASA.

The Space Station will be brought on-line in such phasing that full required STS funding will be available as and when needed. Our long range plan for maintaining the STS capability includes continuing orbiter production, increasing flight rate to at least 40 flights per year and augmenting the system with upper stages, derivative vehicles, platforms, the Space Station, and any other elements required to make most efficient use of the STS assets.

Furthermore, as the nation's Expendable Launch Vehicle programs are phased out, concerns have been expressed regarding assured launch capability, particularly in the event of some catastrophe in the Shuttle program or in times of crisis and conflict. The answer to these concerns lies within the Space Transportation System. The availability of Shuttle Solid Rocket Boosters permits the timely development of unmanned Shuttle-derived launch vehicles. Such launch vehicles could provide performance levels to satisfy national requirements, could allow greater launch site flexibility, and could present cost-effective replacements for today's Deltas, Atlases and Titans. Furthermore, this approach to providing assured launch capability is fully supportive of the President's commitment to the Space Transportation System.

D-14. As we understand NASA's proposal, the initial complement of Space Station components is comprised of the following:

Elements

- Manned base in low inclination orbit
    - o Crew of 6-8
    - o Living quarters module
    - o Utility module
        - -- elecrical power
        - -- thermal control
        - -- attitude control
        - -- data processing
    - o Docking hub
        - -- crew rotation and resupply 3-6 months
    - o Two attached operations modules
        - -- Scientific research and technology development requiring extensive manned interaction
- Co-orbiting and polar unmanned platforms
    - -- Changeable payload accommodations for activities requiring minimum disturbance

Please provide the time phased funding profile that supports these capabilities. Include cost estimates for the associated launch and mission support requirements as well as new support capabilities necessary to make the station operationally functional (i.e., additional TDRSS resources, teleoperators, etc.).

The time phased cost to achieve initial operating capability is shown. This cost assumes that the Teleoperator Maneuvering System (TMS) will be developed earlier as part of the Shuttle infrastructure. However, the $8 billion includes the cost for space basing the TMS and increasing its servicing capability. Our current assessment of the required information band width leads us to the conclusion that the current TDRSS system can adequately handle the required data transmission for the rest of the century. Modifications to the STS ground support system to accommodate the Space Station are included in the DDT&E cost.

FY 84 $ IN MILLIONS SPACE STATION

MFA-13
7/29/83

PROGRAM PHASE 1

	FY 85	FY 86	FY 87	FY 88	FY 89	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97	FY 98	FY 99	TOTAL
SPACE STATION			410	1150	1620	1970	1775	1050	190							8165
DEFINITION	210	280	100	60	50											700
TOTAL	210	280	510	1210	1670	1970	1775	1050	190							8865

SPACE STATION MODULES	
-LAB (2)	550
-HAVITABILITY	1000
-LOGISTICS (2)	1025
-COMMAND/UTILITY	2675
-INTERFACE	1500
SUBTOTAL	6750
-28.5 PLATFORM	650
-POLAR PLATFORM	300
-TMS (UPGRADING/2ND UNIT)	90
-SERVICING CAPABILITY	85
-OPERATIONS CAPABILITY	290
TOTAL	8165

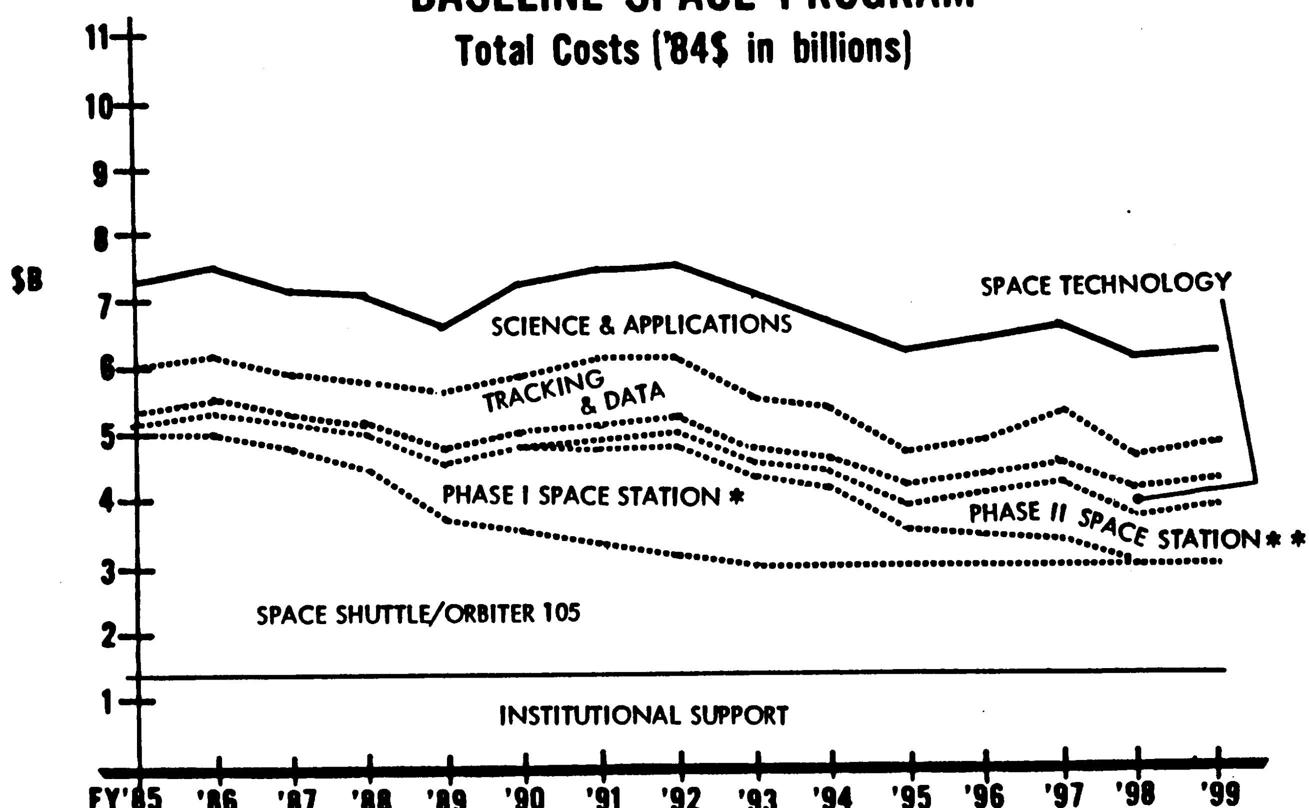
D-15. What is your projection of the life cycle cost for the permanently manned Space Station you propose?

It is not appropriate, at this time, to estimate the life cycle costs since a precise understanding of the traffic and the detailed design of the Space Station is not currently available. NASA's plan for an intensive two year definition endeavor will accurately define the Space Station design and within two years, we will have a better understanding of the future traffic. Therefore, a reliable assessment of the life cycle cost would, at this time, not be possible.

D-16. In what portion of the NASA budget are the Shuttle launch costs associated with the Space Station?

The Shuttle launch costs are included in the operations segment of the Office of Space Flight budget.

NASA
BASELINE SPACE PROGRAM
Total Costs ('84$ in billions)



*Includes Teleoperator Maneuvering System, Polar Platform, Aft Cargo Carrier, Crew Equipment, Technology & Advanced Development.

**Includes Orbital Transfer Vehicle, Platform, Manned Orbital Transfer Vehicle Capsule,

NASA
BASELINE SPACE PROGRAM SUMMARY

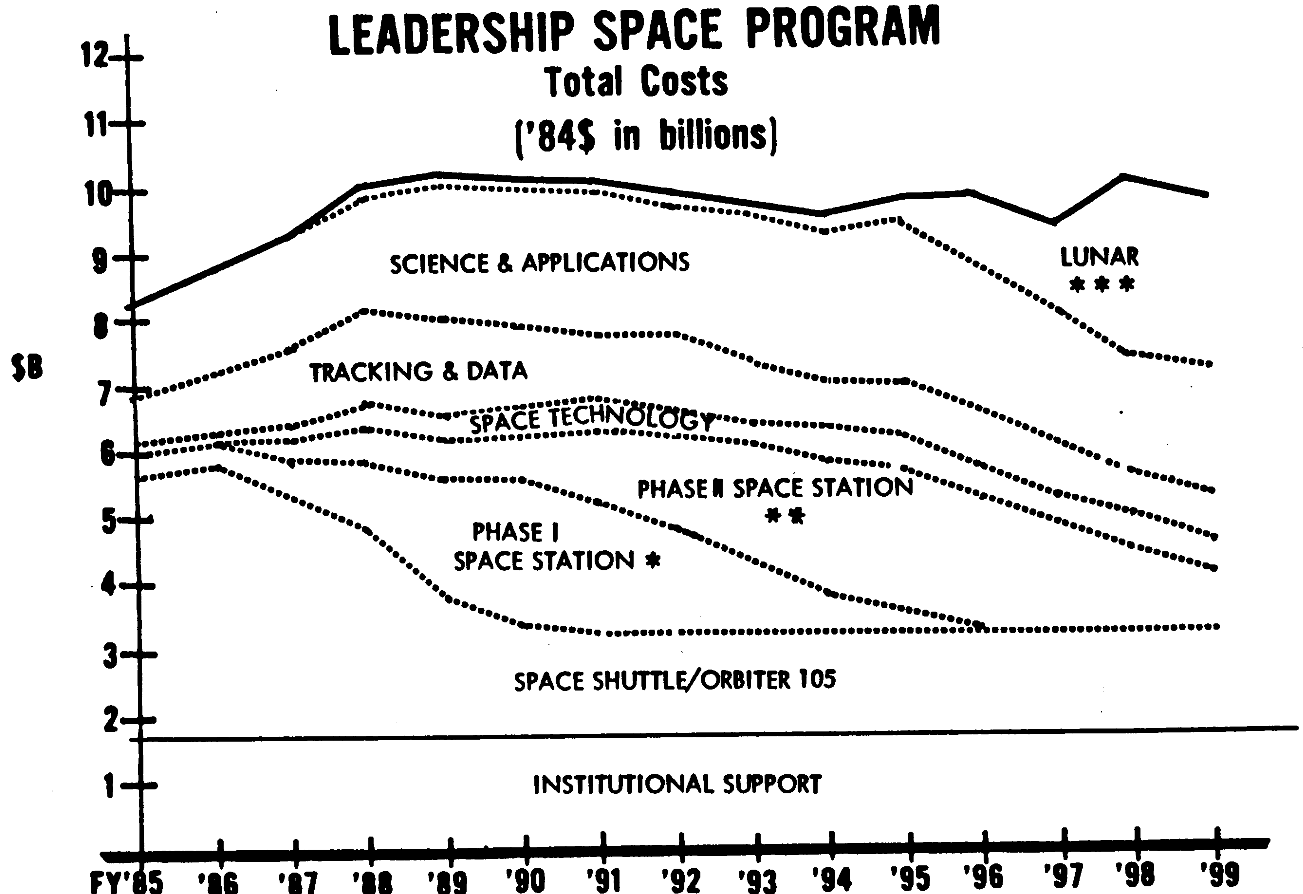
(FY 1984 $ IN BILLIONS)

5-31-83

	FISCAL YEARS 85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	15 YEAR TOTAL
Science and Applications	1.3	1.2	1.1	1.1	1.1	1.1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	18.4
Tracking and Data	.7	.7	.7	.7	.8	.9	1.0	.9	.8	.8	.7	.7	.7	.7	.7	11.5
Space Technology	.1	.1	.1	.1	.1	.2	.1	.2	.2	.2	.1	.2	.2	.2	.2	2.1
Phase II Space Station							*	.2	.2	.4	.4	.7	1.0	.8	.9	4.6
Phase I Space Station	.2	.3	.4	.6	.8	1.4	1.7	1.7	1.5	1.0	.6	.4	.3			10.9
Shuttle/OV-105	3.6	3.6	3.3	3.0	2.4	2.1	1.8	1.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6	32.7
Institutional Support	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	21.0
BASELINE TOTAL	7.3	7.3	7.0	7.0	6.7	7.1	7.3	7.4	7.0	6.0	6.1	6.3	6.5	6.0	6.1	101.6

Numbers may not add due to rounding
* = Less than $.05 Billion

NASA
LEADERSHIP SPACE PROGRAM
Total Costs
('84$ in billions)



*Includes Teleoperator Maneuvering System, Polar Platform, Aft Cargo Carrier, Crew Equipment, Technology & Advanced Development.

**Includes Orbital Transfer Vehicle, Platform, Manned Orbital Transfer Vehicle Capsule, Technology & Advanced Development.

***Includes Shuttle Derived Launch Vehicle.

NASA
LEADERSHIP SPACE PROGRAM SUMMARY

(FY 1984 $ IN BILLIONS)

5-31-83

	FISCAL YEARS															15 YEAR
	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	TOTAL
Lunar	*	*	*	.1	.1	.2	.1	.2	.2	.2	.3	1.1	1.5	2.7	2.7	9.4
Science and Applications	1.5	1.6	1.7	1.9	2.1	2.2	2.2	2.1	2.2	2.2	2.6	2.2	2.0	1.8	2.0	30.2
Tracking and Data	.7	.7	1.1	1.4	1.4	1.3	1.0	.9	.9	.7	.8	.8	.8	.7	.7	13.8
Space Technology	.1	.2	.3	.4	.5	.5	.5	.4	.4	.4	.4	.4	.4	.4	.4	5.9
Phase II Space Station		.1	.3	.3	.6	.6	1.2	1.5	1.9	2.0	2.2	1.9	1.5	1.2	.7	15.9
Phase I Space Station	.5	.5	.7	1.4	1.7	2.0	1.9	1.5	.9	.6	.3	.1				12.1
Shuttle/OV-105	3.9	4.0	3.5	2.9	2.1	1.8	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	32.6
Institutional Support	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	25.1
LEADERSHIP TOTAL	8.4	8.8	9.3	10.1	10.2	10.2	10.1	9.8	9.7	9.4	9.9	9.8	9.5	10.0	9.8	145.0

Numbers may not add due to rounding
* = Less than $.05 Billion

D-17. What specific support is required to make Space Station a leadership program?

No major new support activities will be required by a manned space station to assure a leadership position. The station concept is highly autonomous in orbit and envisions minimum ground support beyond launch and logistics support. In the critical areas of asset construction, assembly and servicing, the manned space station will inherit support systems developed for Shuttle, such as teleoperators, EVA equipment and maintenance/repair procedures. While the TDRSS network will have sufficient bandwidth capability through the year 2000, the deployment of multiple platforms in different orbits with concurrent transmission requirements may necessitate additional satellites in the TDRSS network.

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